

REMARKS

In the Office Action the Examiner noted that claims 1-4 were pending in the application and the Examiner rejected all claims. The Examiner's rejections are traversed below.

The Rejections

On pages 2-4 of the Office Action the Examiner rejected claims 1-4 as unpatentable over U.S. Patent 5,526,643 to Mukaihira et al. in view of "design choice" or as unpatentable over U.S. Patent 6,644,021 to Okada et al. in view of "design choice".

The Prior Art

The Mukaihira et al. reference is directed to a system for diagnosing deterioration of a catalyst. The temperature of the catalyst is estimated using an operating state signal of the engine by using a diagnostic device. The conversion efficiency of the catalyst is calculated from the output of oxygen sensors. The deterioration state of the catalyst is diagnosed on the basis of the corrected temperature by the diagnostic device. Mukaihira et al. does not disclose features relating to regeneration control for a catalyst, nor does it disclose prohibition of a rich condition control based on a detected temperature.

U.S. Patent No. 6,644,021 to Okada et al. is directed to an exhaust gas purifying apparatus of an internal combustion engine in which the temperature of an occlusion-type NO_x catalyst is increased to emit SO_x when the temperature of the occlusion-type NO_x catalyst is not less than a set temperature. This is done to prevent deterioration of fuel consumption and to enable the regeneration of a catalyst device by efficiently desorbing a sulfur compound from the catalyst device. In particular, Okada et al. discloses performing S purge control to control the regenerating of the catalyst device by desorbing a sulfur compound from the catalyst.

The Claims Distinguish Over Mukaihira et al.

The present claimed invention as set forth, for example, in claim 1, is directed to a catalyst-deterioration diagnostic system. In contrast, Mukaihira et al. does not contain any teaching or suggestion relating to "a direct reduction type NO_x catalyst", "a rich condition operation" or "a lean condition operation" as recited, for example, in claim 1. Further, Mukaihira et al. does not disclose the feature of prohibiting rich condition control based on whether the temperature detected by a catalyst temperature detector, is greater than a set temperature which is within a predetermined temperature range of between 400°C and 500°C.

Mukaihira et al. relates to diagnosis of the deterioration state of a catalyst and does not contain any description of regeneration control or prohibition of a rich condition control as set forth in the claims.

On page 2 of the Office Action the Examiner cited columns 8-10 for disclosing a predetermined temperature range of 350°C and 450°C. These temperatures are used to describe boundaries of "conversion efficiency" as described at column 9, lines 12-25. According to Mukaihira et al., a deterioration judgment of the catalyst is carried out in a range (regions II and III). Each temperature is higher than T_{x1} , and in a range (region II) whose temperature is between T_{x1} and T_{x2} . Correction of the conversion efficiency is calculated based on actual measurement data, while no correction is made in a range (region II) whose temperature is higher than T_{x2} . Mukaihira et al. is completely devoid of any suggestion which would provide motivation to associate the values 350°C (T_{x1}) and 450°C (T_{x2}) with "rich condition operation" and "NOx catalyst regeneration" in accordance with the present claimed invention. Thus, it is submitted that the temperature limitations described in Mukaihira et al. (350°C and 450°C) have absolutely nothing to do with the temperature range in which the rich condition control is prohibited according to the claimed invention.

Referring to column 4, lines 33-37 of Mukaihira et al., the invention is summarized as follows:

... the temperature of the catalyst can be known without using a thermometer. Moreover, since the deterioration state of the catalyst is decided after the correction of the calculated conversion efficiency, it is diagnosed precisely.

Thus, Mukaihira et al. has nothing to do with the effects or result of the present claimed invention described at paragraph [0019] of the specification as follows:

And, by the NOx catalyst regeneration method of this NOx purifying system and the NOx purifying system, the rich condition control can be performed avoiding the temperature range of the catalyst in which the NOx concentration is increased at the catalyst outlet during the rich condition control. Therefore, it is possible to efficiently purify the NOx in the exhaust gas while preventing the NOx from being discharged into the atmospheric air. Moreover, since the direct reduction type NOx catalyst can surely be regenerated under the rich condition control, the fuel cost can be prevented from worsening.

On pages 2 and 3 of the Office Action, the Examiner states:

Regarding the specific range of the catalyst air ratio and the catalyst temperature, it is the examiner's position that a range between 400°C and 500°C of the catalyst temperature, would have been an obvious matter of design choice well within the level of

ordinary skill in the art, depending on variables such as mass flow rate of the exhaust gas, as well as the size of the engine, properties of materials for making the NO_x storage catalyst, and the controlled temperature of the catalytic converter.

It is submitted that the Examiner's statement completely ignores the fact that Mukaihira et al. has no teaching or suggestion relating to any temperature range associated with "rich condition operation" and "NO_x catalyst regeneration" as set forth in the present claimed invention. Therefore, it is submitted that the Examiner's reliance upon "design choice" is misplaced.

The Claims Distinguish Over Okada et al.

Okada et al. describes a process related to an occlusion-type NO_x catalyst. In contrast, the present claimed invention relates to a direct reduction-type NO_x catalyst which has different characteristics than the occlusion-type NO_x catalyst. Further, the present invention does not relate to restoration from poisoning with sulfur but to a restoration of the capacity to directly reduce NO_x. As pointed out in paragraphs [0011] – [0013] of the specification, the present invention was developed based on particular characteristics of direct reduction-type catalysts. Further, as explained in paragraph [0042] of the specification, the present invention provides a method and system which avoids increases in the temperature range of the catalyst for the concentration of NO_x at the catalyst outlet during rich condition control. Therefore, the NO_x in the exhaust gas can be efficiently purified while the NO_x is prevented from being discharged into the atmosphere. In addition, fuel costs are reduced.

Okada et al. discloses that, with respect to an occlusion-type catalyst, that when the temperature of the catalyst is raised above the set temperature (600°C to 800°C), S purge control (regeneration control against poisoning with sulphur) is carried out.

In contrast, the present claimed invention relates to "a direct reduction-type catalyst" which has different characteristics from an "occlusion-type catalyst" (see the subject specification, paragraphs [0011] – [0013]). Also, the present claimed invention is directed to prohibiting rich condition control when the temperature rises above a predetermined temperature and this feature clearly differs from the disclosure of Okada et al.

In Okada et al., the described temperature of 250°C to 350°C is an activation temperature of the occlusion-type NO_x catalyst, while the temperatures 650°C, 600°C to 800°C, and 650°C to 800°C are for converting the air-fuel to a rich state in carrying out S purge (column 6, lines 47-57 and column 11, lines 27-32). The disclosure in Okada et al. and particularly the

above-described temperatures do not teach or suggest a temperature range of 400°C to 500°C for prohibiting rich condition control as set forth in the present claimed invention.

It is submitted that there is no teaching or suggestion in Okada et al. which relates to a direct reduction-type catalyst and the feature wherein a rich condition operation is prohibited above the prescribed temperature.

As described at column 12, lines 8-13 of Okada et al.,:

... the exhaust gas purifying apparatus of the internal combustion engine according to the present invention enables the stable regeneration of the catalyst device and prevents the deterioration of the exhaust gas characteristics caused by the deterioration of the catalyst device.

This has nothing to do with features of the present claimed invention as described at paragraph 19 of the subject application which states:

And, by the NOx catalyst regeneration method of this NOx purifying system and the NOx purifying system, the rich condition control can be performed avoiding the temperature range of the catalyst in which the NOx concentration is increased at the catalyst outlet during the rich condition control. Therefore, it is possible to efficiently purify the NOx in the exhaust gas while preventing the NOx from being discharged into the atmospheric air. Moreover, since the direct reduction-type NOx catalyst can surely be regenerated under the rich condition control, the fuel cost can be prevented from worsening.

On pages 3 and 4 of the Office Action, the Examiner takes the position that:

Regarding the specific range of the catalyst air ratio and the catalyst temperature, it is the examiner's position that a range between 400°C and 500°C of the catalyst temperature, would have been an obvious matter of design choice well within the level of ordinary skill in the art, depending on variables such as mass flow rate of the exhaust gas, as well as the size of the engine, properties of materials for making the NOx storage catalyst, and the controlled temperature of the catalytic converter.

As discussed above with respect to Mukaihira et al., it is submitted that the Examiner's statement ignores the fact that Okada et al. is directed to an occlusion-type catalyst as opposed to the claimed invention which is directed to a direct reduction-type catalyst. Also, Okada et al. does not teach or suggest any features relating to prohibiting rich condition control when the temperature rises above a predetermined temperature. Therefore, it is submitted that the Examiner's position regarding "design choice" is deficient and should be withdrawn.

Claims 1-4 Patentably Distinguish Over the Prior Art

Referring to claim 1 and for the reasons described in detail above, it is submitted that none of the prior art teaches or suggests:

“A method for regenerating a NOx catalyst in a NOx purifying system having a direct reduction type NOx catalyst provided in an exhaust passage and directly decomposing NOx during a lean condition operation and being regenerated during a rich condition operation, comprising prohibiting a rich condition control when the temperature detected by a catalyst temperature detector is greater than a set temperature which is within a predetermined temperature range of between 400°C and 500°C.”

Therefore, it is submitted that claim 1 patentably distinguishes over the prior art.

Referring to claim 2, it is submitted that the prior art does not teach or suggest the claimed NOx purifying system for a direct reduction type NOx catalyst:

“A NOx purifying system direct reduction type NOx catalyst provided in an exhaust passage and directly decomposing NOx during a lean condition operation and being regenerated during a rich condition operation, which comprises a catalyst temperature detector, and a control device to prohibit a rich condition control when the temperature detected by the catalyst temperature detector is greater than a set temperature which is within a predetermined temperature range of between 400°C and 500°C.”

Therefore, it is submitted that claim 2 patentably distinguishes over the prior art.

Claim 3 is directed to a method for regenerating a direct reduction type NOx catalyst which includes:

detecting the direct reduction type NOx catalyst temperature; and regenerating the NOx while performing a rich condition operation only when the detected temperature is less than a set temperature which is between 400°C and 500°C.

Therefore, it is submitted that claim 3 patentably distinguishes over the prior art.

Claim 4 is directed to a NOx purifying system having a direct reduction type NOx catalyst which includes:

a catalyst temperature detector detecting a temperature of the direct reduction type NOx catalyst; and

a control device causing a rich condition control to be performed only when the temperature detected by the catalyst temperature detector is less than a set temperature which is between 400°C and 500°C.

Therefore, it is submitted that claim 4 patentably distinguishes over the prior art.

Summary

It is submitted that none of the references, either taken alone or in combination, teach the present claimed invention. Thus, claims 1-4 are deemed to be in the condition suitable for allowance. Reconsideration of the claims and an early Notice of Allowance are earnestly solicited.

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

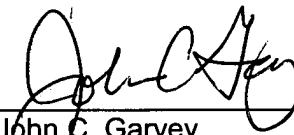
If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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